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## ***Ceratothoa carinata* (Isopoda: Cymothoidae) from Japanese scad *Decapterus maruadsi* in coastal waters of the western North Pacific off central-western Japan**

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**Abstract.** Specimens of *Ceratothoa carinata* (Bianconi, 1869) were collected from the buccal cavity of Japanese scad *Decapterus maruadsi* (Temminck & Schlegel, 1843) commercially caught in the western North Pacific off Wakayama, Kochi, and Miyazaki prefectures, central-western Japan. These collections, along with the previous records of *C. carinata* from carangids in Japan, indicate that this parasite widely occurs in coastal waters of the western North Pacific and the adjacent Seto Inland Sea off central-western Japan. Morphological variations were found in the posterior margin of the female's pleotelson.

**Key words:** *Ceratothoa carinata*, Isopoda, Cymothoidae, fish parasite, *Decapterus maruadsi*, geographical distribution

The Japanese scad, *Decapterus maruadsi* (Temminck & Schlegel, 1843), is a commercially important carangid fish caught in coastal waters of the Indo-West Pacific (Froese & Pauly, 2016; FAO FishFinder, 2016). This species occurs in waters around central-western Japan (Senou, 2013) and is known to be infected by the cymothoid isopod *Ceratothoa carinata* (Bianconi, 1869) in the western North Pacific off Kanagawa Prefecture (Nunomura, 2006, as the Sagami Sea) and Mie Prefecture (Saito, 2009, 2014) and the western Seto Inland Sea off Oita Prefecture (Nagasawa *et al.*, 2014) (Fig. 1). This fish also has been reported to harbor unidentified cymothoids in Okayama and Kochi prefectures (Saito, 2009). Recently, we collected further specimens of

*C. carinata* from *D. maruadsi* in the western North Pacific off central-western Japan.

In total, 59 individuals of *D. maruadsi* were obtained in fishing ports or at fish markets in central-western Japan from February 2012 to May 2016: these fish were commercially caught in the Kii Channel (locality 4 in Fig. 1) and its southern Pacific waters (locality 5 in Fig. 1) off Wakayama Prefecture in August and February 2012 (n=20, 202–306 [mean 244] mm fork length [FL] and n=18, 242–316 [276] mm FL), respectively; Tosa Bay (locality 6 in Fig. 1) off Kochi Prefecture in May 2016 (n=17, 173–228 [198] mm standard length [SL]); and the Hyuga-nada Sea (locality 7 in Fig. 1) off Miyazaki Prefecture in May 2016 (n=4, 251–260 [255] mm SL). The fish were brought to the laboratory, measured for FL or SL in millimeters, and examined for the presence or absence of isopods in the buccal cavity. When iso-

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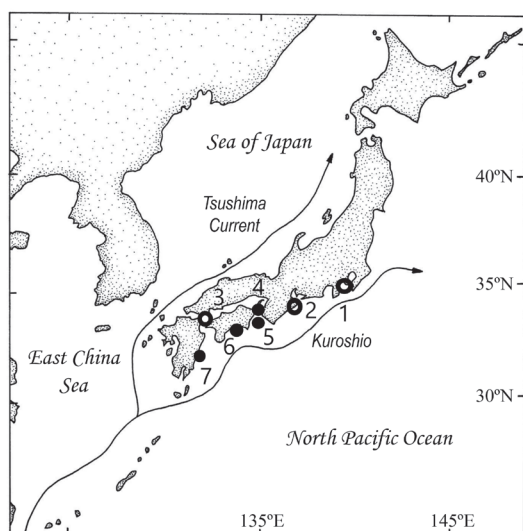


Fig. 1. Map of the Japanese Archipelago, showing the localities where *Ceratothoa carinata* was collected in the previous (open circles) and present (closed circles) studies. Localities 1, 2, and 3 are the western North Pacific off Kanagawa Prefecture (Nunomura, 2006) and Mie Prefecture (Saito, 2009, 2014), and the western Seto Inland Sea (Nagasawa *et al.*, 2014), respectively. Localities 4, 5, 6, and 7 are the Kii Channel, its southern Pacific waters, Tosa Bay, and the Hyuga-nada Sea, respectively (present study).

pod was found, they were carefully removed using forceps and fixed in 70% ethanol. Isopods were identified based on Nunomura (2006), Saito (2009), Martin *et al.* (2013), and Hadfield *et al.* (2016). Voucher specimens of *C. carinata* are deposited in the Crustacea (Cr) collection of the National Museum of Nature and Science, Tsukuba, Ibaraki Prefecture, Japan (NSMT-Cr 24608, 24609, and 24610 from the Kii Channel, Tosa Bay, and the Hyuga-nada Sea, respectively). The scientific and common names of fishes used in this paper follow Froese & Pauly (2016).

Ten (17.0%) of the 59 individuals (three [15.0%] of the 20 fish from the Kii Channel; two [11.1%] of the 18 fish from the Pacific waters south of the channel; three [17.6%] of the 17 fish from Tosa Bay; and two [50.0%] of the four fish from the Hyuga-nada Sea) of *D. maruadsi* examined in this study were found to be infected by cymothoids in the buccal cavity. The cymothoids collected are all identified as *C. carinata*. As reported earlier (Nagasawa *et al.*, 2014), a pair of an ovigerous female and a male of *C.*

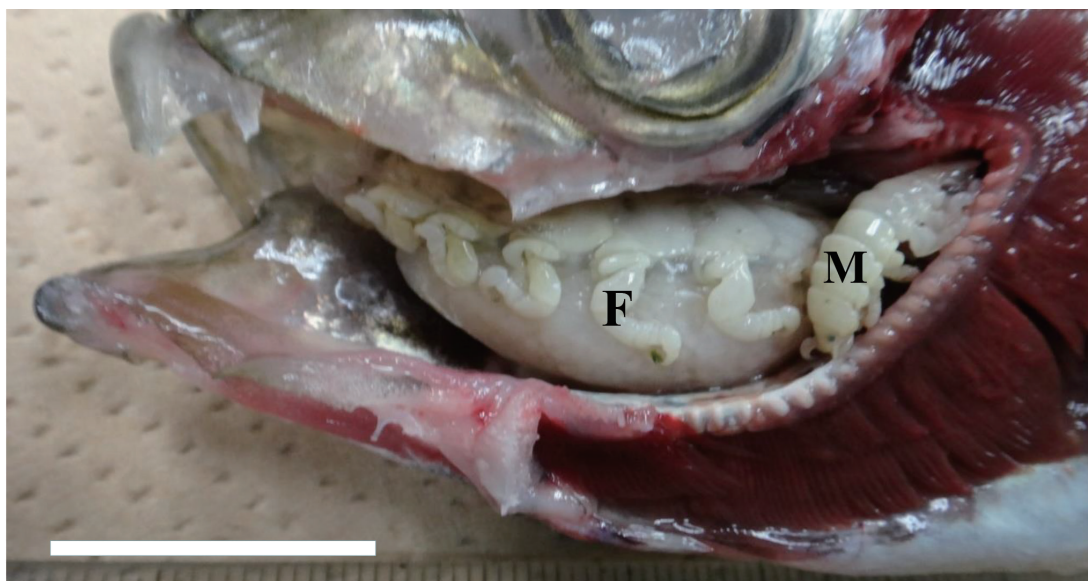


Fig. 2. Ovigerous female (F) and male (M) of *Ceratothoa carinata* in the buccal cavity of *Decapterus maruadsi*. The operculum and the first gill arch and filaments were removed to show the female and male of *C. carinata*. The photographed fish was caught in the Hyuga-nada Sea (locality 7 in Fig. 1) off Miyazaki Prefecture in May 2016. Scale bar: 20 mm.

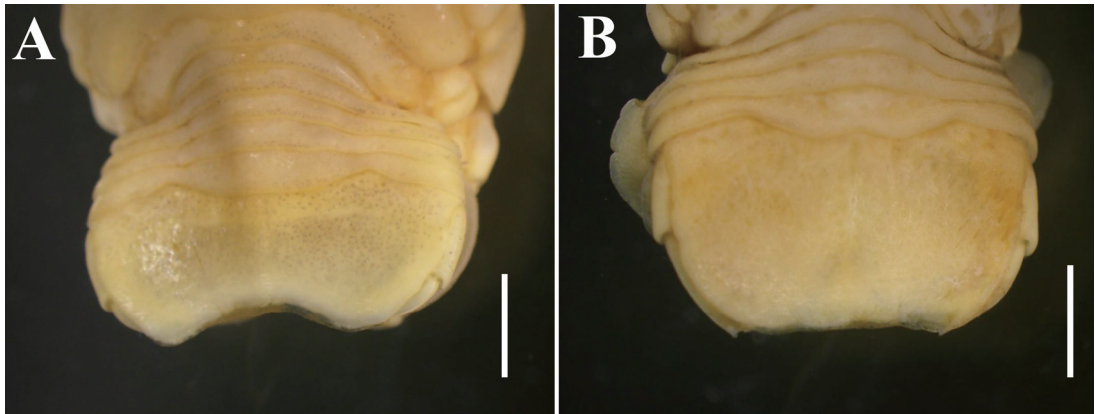


Fig. 3. Pleotelson of ovigerous females of *Ceratothoa carinata*, NSMT-Cr 24608 (A, 24.5 mm long; B, 26.0 mm long), dorsal view. A, pleotelson with a concave posterior margin; B, pleotelson with a nearly straight posterior margin. The females were collected from *Decapterus maruadsi* in the Kii Channel (locality 4 in Fig. 4) off Wakayama Prefecture in August 2012. Scale bars: 2 mm in A and B.

*carinata* was usually found in the host's buccal cavity (Fig. 2): the female was constantly found on the bottom of the host's buccal cavity, while the adult male occurred beside or slightly posterior to the female. This adult male's position was different from that shown in a photograph (fig. 1A in Nagasawa *et al.*, 2014), in which the male attached ventrally to the roof of the host's buccal cavity. The ovigerous females ( $n=10$ ) and males ( $n=10$ ) collected in this study are 24.4–39.9 (mean 29.9) mm long  $\times$  9.3–16.5 (11.8) mm wide, and 5.0–14.5 (9.8) mm long  $\times$  2.0–4.5 (3.6) mm wide, respectively. The morphology of these females fits the redescription of *C. carinata* by Martin *et al.* (2013) and Hadfield *et al.* (2016) and the photographs of the species by Saito (2009, as *Ceratothoa* sp.) and Nagasawa *et al.* (2014). In particular, the pleotelson with a concave posterior margin (Fig. 3A) is one of the morphological features to characterize the female of the species (Martin *et al.*, 2013), and this feature was more or less recognized in nine of the 10 female specimens collected in this study. However, one female specimen (NSMT-Cr 24608, 26.0 mm long) from the Kii Channel possessed the pleotelson with a nearly straight posterior margin (Fig. 3B), which suggests that intraspecific

variation is present in the shape of the posterior margin of the pleotelson. A detailed study of such variation is needed using many specimens of the species.

*Ceratothoa carinata* has been reported from the following three species of carangids in Japanese waters: white trevally *Pseudocaranx dentex* (Bloch & Schneider, 1801) (Nunomura, 2006), amberstripe scad *Decapterus muroadsi* (Temminck & Schlegel, 1844) (Nunomura, 2006), and Japanese scad *D. maruadsi* (Saito, 2009, 2014; Nagasawa *et al.*, 2014). The collections of *C. carinata* in this study, along with the previous records of the species from these carangids in Japan, indicate that this parasite widely occurs in coastal waters of the western North Pacific and the adjacent Seto Inland Sea off central-western Japan (Fig. 1). Since *D. maruadsi* migrates from the Kii Channel to the eastern Seto Inland Sea (Takeda, 2002), *C. carinata* is likely to be found in the latter sea. The past and present sampling localities of *C. carinata* are located in the temperate coastal waters, which are largely affected by the warm-water current, Kuroshio (Fig. 1). No information, however, is yet available on the distribution of *C. carinata* in the southern Sea of Japan off western Honshu Island and the East China Sea off Kyushu Is-

land, where *D. maruadsi* and *P. dentex* occur as well and the Tsushima Current, a branch of the Kuroshio, flows. It is thus desirable to examine these carangids from the two seas in order to clarify the geographical distribution of *C. carinata* in Japanese waters.

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